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Future developments in modelling and monitoring of volcanic ash clouds: outcomes from the first IAVCEI-WMO workshop on Ash Dispersal Forecast and Civil Aviation (Geneva, Switzerland, 18-20 October 2010)

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The April-May 2010 Eyjafjallajökull eruption brought to light the harmful effects of volcanic ash on civil aviation and the importance of robust ash forecasting based on the combination of Numerical Weather Prediction (NWP), Volcanic Ash Transport and Dispersal Models (VATDM), and data acquisition. The IAVCEI-WMO Ash Dispersal Forecast and Civil Aviation workshop has produced a consensual document describing the characteristics and range of application of different VATDMs, identifying the needs of the modelling community, investigating new data-acquisition strategies and discussing how to improve communication between the volcanological community and operational agencies.

The workshop was held at the World Meteorological Organization (WMO) Geneva headquarters under the sponsorship of the Faculty of Sciences of the University of Geneva, IAVCEI, and Canton of Geneva, and organized by scientists from the University of Geneva (Switzerland), the Barcelona Supercomputing Center (Spain), the Aeronautical Meteorology Division of the WMO, and the British Geological Survey (UK). Fifty-two volcanologists, meteorologists, atmospheric dispersion modellers, and space and ground-based monitoring specialists from 12 different countries were gathered (attendance by invitation only), including representatives from 6 Volcanic Ash Advisory Centers (VAACs) and related institutions.

A model benchmark exercise (based on the Hekla 2000 eruption) was carried out before the workshop. The definition of the benchmark included erupted mass, plume height, tephra total grain size distribution, particle size-dependent densities, and meteorological datasets (ECMWF ERA-40 and NCEP/NCAR reanalysis-1). Model outputs were specified as concentration contour maps at different flight levels and time instants, vertical concentration profiles at a given point, and tephra ground load maps. The benchmark exercise was performed by 12 VATDMs (ASH3D, ATHAM, FALL3D, FLEXPART, HYSPLIT, JMA, MLDP0, MOCAGE, NAME, PUFF, TEPHRA2, and VOL-CALPUFF). This includes the vast majority of VATDMs existing worldwide and all models currently operative at VAACs. A test case of such extent had never been done before. In addition, two detailed tables have been compiled to define application conditions and outputs of both VATDMs and selected data-acquisition techniques associated with ash detection (namely AIRS, ASTER, AVHRR, GOES-11, GOES-12,13,14,15, Grimm EDM 107, Grimm Sky OPC, IASI, IMO-radar, Infrasonic Array, IR-SO2, LIDAR, MISR, MODIS, MTSAT, OMI, PLUDIX, SEVIRI, Thermal Camera, UV Camera, VOLDORAD).

After three days of dedicated talks, break-out sessions, and extensive plenary discussions (focusing on dispersal modelling, data acquisition, and decision making during volcanic crises), suggestions were made for future model improvements including some specific sedimentation processes (e.g., particle aggregation) and a better definition of the source term (i.e. plume dynamics). In addition, new improved strategies of ash forecasting should be designed to account for uncertainties associated with input parameters, volcanic activity scenarios and model variability (e.g., ensemble forecasting). Robust dispersal forecasting also needs to be accompanied by multidisciplinary data acquisition at different time and space scale that can be used for both data assimilation and model validation (this should include direct measurements both in the cloud and on the ground). Monitoring priorities should address the characterization of the source term (Ht, MER, erupted mass, grain-size distribution) and the far field. Outcomes can be found at the workshop website: www.unige.ch/hazards/Workshop.html